NATIONAL SUMMARY: RECOMMENDATIONS AND CONCLUSIONS

Managers of coral reef ecosystems in the United States and the Pacific Freely Associated States assessed and prioritized management needs at a Coral Reef Managers' Workshop held on O'ahu, HI in February 2000. (See Table 11.) The managers' table of priorities was updated and the USCRTF Points of Contact have assured that the resulting set of recommendations met local priority needs for FY02. The priorities in this table are similar to those in the National Coral Reef Action Strategy.

The table should be read as follows. If work had recently been completed, was underway, or planned and adequately supported, the item was not listed as a priority, although it may be of local importance. This was also true for mapping priorities, as deep-reef mapping resources were limited by the need to complete shallow-reef mapping first. At the time this report was being finalized, NOAA and DoI were entertaining FY02 proposals for grant support for projects based on the following priorities.

Complete Mapping and Establish a Monitoring Network – To fill identified information gaps, managers consider mapping, assessing, and monitoring U.S. coral reef ecosystems top priorities for 2002 (Fig. 133). While Puerto Rico and USVI reefs have been mapped, areas with poor water quality need still need final spatial information. Therefore, they are still listed even though mapping activities are well underway to fill those gaps.

To provide the more sophisticated monitoring needed to develop coral reef health indicators[136] for the next biennial report, the level of funding previously allocated for assessing and monitoring was moderately increased. For 2001, about $100,000 was available to each jurisdiction.

For all jurisdictions, training in coral reef monitoring and assessment, and support for assessment and monitoring activities is needed so local capacity can be developed. This is especially true in the Pacific Freely Associated States. Local expertise for assessment and monitoring has been increasing, but funds are a limiting factor, especially as financial support from the Compacts of Free Association is decreasing. Since they are now members of the USCRTF, the Freely Associated States are included in the Mapping, Assessment, and Monitoring Program. Plans are to initiate assessment and monitoring activities there in FY02.

Strengthen MPAs – This will continue to be a high priority for all but the U.S. remote insular reefs, Federated States of Micronesia, and the Marshall Islands. It follows what was accomplished by USCRTF members in 1999 and 2000 to expand and strengthen marine protected areas. And, except for the remote insular reefs where the considerable transit distances and the generally pristine condition of the reefs makes it a lower priority at this time, improved enforcement is a high priority for MPAs.

Figure 133. Mapping, monitoring, and assessment are top priorities, especially for reefs located in more remote and less studied areas (Photo: James Maragos).

Except for Guam who already has 20% of its reef resources protected by no-take provisions, managers are calling for broad-scale strengthening of MPAs to protect shallow-water resources.

Reduce Overfishing – Most managers considered conservation measures related to fisheries a high priority. Fisheries impacts on coral reefs and other benthic habitats are either a high or medium priority for all but the U.S. remote insular reefs.

Reduce Pollution from Runoff – Managing impacts from coastal use of coral reef resources is a high priority for many U.S. jurisdictions and the Freely Associated States. Managers responsible for

[136] Population recruitment statistics, disease incidence, water quality degradation.

Table 11. FY02 management priorities for coral reef ecosystems in the United States and the Pacific Freely Associated States.

		Atlantic/ Caribbean				Polynesia			Micronesia					
MANAGEMENT ACTIONS	PARAMETERS/ INDICATORS	Florida	Puerto Rico	U.S. Virgin Islands	Flower Gardens	Main Hawaiian Islands	Northwestern Hawaiian Islands	American Samoa	Guam	Northern Mariana Islands	Marshall Islands	Federated States of Micronesia	Palau	U.S. Remote Insular Reefs
Mapping	Shallow reefs (<30 m)	H	H	H	L	H	H	H	M	H	L	H	H	M
	Deep reefs (>30 m)	M	L	H	H	L	L	M	L	L	L	L	L	L
Assessment & Monitoring	Rapid assessments & inventories	H	M	H	L	H	H	M	M	H	L	H	H	M
	Benthic cover	H	H	H	L	M	M	M	L	H	L	L	M	M
	Disease	H	H	H	L	L	L	L	L	M	M	M	L	M
	Coral and fish recruitment	H	M	H	M	H	M	M	H	M	L	H	H	M
	Fish abundance & diversity	H	H	H	M	H	H	H	H	H	M	H	H	H
	Invertebrate abundance & diversity	H	M	H	L	H	H	H	H	H	M	H	H	H
	Algal abundance & diversity	M	H	H	H	H	M	H	H	M	M	H	M	M
	Global warming & bleaching	H	M	M	L	L	L	M	L	M	H	L	H	H
	Water & substrate quality	H	H	H	H	M	L	H	H	H	L	H	H	M
	Endemic, endangered & alien species	H	L	L	M	H	M	L	H	H	H	H	H	H
Research	Reef processes	H	M	H	M	M	L	L	M	M	M	M	M	H
Human Dimensions	Socioeconomic value	M	H	M	M	H	M	M	H	H	M	L	H	L
MPAs	Expansion & strengthening of MPAs	H	H	H	H	H	H	H	H	H	L	L	H	M
Fisheries	Overfishing	H	H	H	H	H	M	H	L	H	M	H	H	M
	Habitat impacts	M	H	M	M	H	H	M	M	H	L	M	H	L
	Trade in live reef species	M	H	L	L	H	L	L	M	M	H	M	M	L
Coastal Uses	Land use & watershed management	H	H	H	M	H	L	H	L	H	L	L	H	L
	Physically destructive practices	H	H	M	M	L	L	M	L	H	M	L	M	H
	Ocean recreation	L	H	H	L	H	L	L	H	H	L	L	H	L
	Vessel management	M	H	M	H	H	H	L	H	M	L	L	M	H
	Invasive Species	M	L	L	M	H	H	L	L	L	H	M	M	L
	Enforcement	H	H	H	H	H	H	H	H	H	H	H	H	M
Pollution	Contaminants	M	M	M	M	M	M	H	H	H	M	H	H	M
	Nutrients	H	H	M	L	H	L	M	H	H	L	H	H	L
	Sedimentation	M	H	H	L	H	L	H	H	H	L	H	H	L
	Marine debris	M	M	M	L	M	H	M	L	L	L	H	L	M
Restoration	Restoration of damaged reefs	M	H	L	L	L	L	L	L	M	L	M	L	M
Education & Outreach	Community outreach													
Agency accountability	Interagency coordination	H	M	M	M	H	H	H	L	H	M	M	M	L

H	High priority	M	Medium priority	L	Low-to-no priority

Figure 134. At the Flower Garden Banks National Marine Sanctuary, enforcement is conducted during fly-overs by the U.S. Coast Guard (Photo: FGBNMS).

shallow-water coral reef resources near urbanized coastal areas[137] and those off high islands[138] ranked land-use and watershed conservation a high priority for their near-shore reef ecosystems.

Build a Better System of Enforcement – The managers with responsibility for coral reef resources who helped prepare this report and the USCRTF Points of Contact all made enforcement a high priority. Except for remote insular refuges, measures to conserve coral reef resources (e.g., no-take closures, harvest limits) within most MPAs need adequate enforcement to assure success (Fig. 134). More effective enforcement is needed both within and outside MPAs. Difficulties in patrolling and enforcing regulations are almost insurmountable because of the vast distances covered by many jurisdictions, especially the recently-created Northwestern Hawaiian Island Coral Reef Ecosystem Reserve and the remaining remote Pacific National Wildlife Refuges.

Increase Community Involvement – Community outreach is a high priority for all areas except the mostly uninhabited Northwestern Hawaiian Islands and the U.S. remote insular reefs (Fig. 135).

Increase Cooperation Among Agencies – Interagency coordination is either a medium or high priority for all but Guam and the U.S. remote insular reefs. Additionally, participants at the 2001 Pacific managers workshop agreed 1) a coherent national and international policy for coral reefs is needed, and 2) a Federal law that provides protection for reef ecosystems is the best way to attain this.

CONCLUSIONS

There is good news and bad news about U.S. coral reef ecosystems. The good news is the tremendous headway made so far to begin filling gaps in information, mapping, establishing a consistent monitoring program, making the public aware of the importance of preserving reefs, and getting their active participation in the program. The new U.S. legislation, congressional funding, and leadership provided by the USCRTF have resulted in new resources that have already made a difference in understanding and conserving reefs. The concerted efforts to initiate mapping, assessment, monitoring, research, and restoration will provide a consistent basis for assessing the status and trends of and tracking changes in coral reef ecosystems. Also, MPAs and the no-take areas are being strengthened and expanded, further protecting critical resources.

The bad news is that current enforcement is inadequate to protect MPAs, particularly remote coral reefs where ships and enforcement personnel are seldom available. In general, a lot more quantitative, comparable information is needed.

Basic mapping has yet to be done for over 85% of the reefs. Except where mapped, the available data are just estimates. This is especially true for areas covered by no-take provisions. Many reef areas need basic assessments and biotic inventories to fill significant gaps limiting the ability of managers to determine the condition of jurisdictional coral reefs, including overall biological diversity, popu-

Figure 135. An outreach activity at the Hawaiian Humpback Whale National Marine Sanctuary. Volunteers count whale sightings and document behavior (Photo: Naomi McIntosh).

[137] Florida, Puerto Rico, USVI, the Main Hawaiian Islands, the Flower Garden Banks National Marine Sanctuary.
[138] American Samoa, Guam, and CNMI.

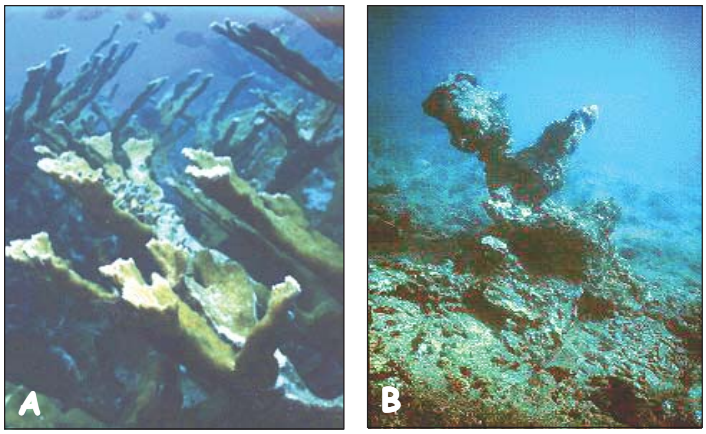

Figure 136. Elkhorn coral, once abundant throughout the Caribbean has been heavily impacted by (A) disease, bleaching, hurricanes, turbidity, and (B) siltation (Photos: Matt Kendall and E.C. Peters)

lation abundance, species recruitment, and the incidence of disease. Comparable long-term monitoring needs to be sponsored and integrated across regions. To track changes in ecosystem health and evaluate the effectiveness of measures to conserve and protect coral reef ecosystems, grants to State and Territorial agencies need to be continued for at least the next 5-10 years, ideally beyond that.

Only a nationally-coordinated program can provide reef managers the advice, support, and resources needed to 1) initiate the bold conservation measures necessary to reverse the downward trends of degraded reefs, and 2) maintain the quality of healthy reefs. On degraded reefs, water and substrate quality must be improved, overfishing and the gear damage reduced, invasive species controlled, and other human stresses minimized. Finally, public awareness and education activities need to be enhanced and expanded to develop cooperation. Renewed citizen awareness and a collective ethic for the sustained use of coral reef ecosystems in the United States and Freely Associated States need to be generated.

Every U.S. reef system has suffered varying degrees of impact from natural or human disturbance. For example, from the combined impacts of hurricanes, reduced urchin and fish herbivory, high nutrient input, coral diseases, and bleaching in the Caribbean, there has been a measured decrease in coral cover. The FKNMS recorded a 37% decline in coral cover over the past five years, and reported that other severe impacts predated their monitoring of the Florida Keys coral reef ecosystem. A series of earlier disasters were responsible for the near elimination of dense stands of elkhorn and staghorn coral from areas in the Florida Keys, Puerto Rico, and the USVI (Fig. 136). At the extreme end, the eight hurricanes that have struck the USVI over the past two decades, reduced live *Acropora* corals at the Buck Island National Park, USVI by 85%. In their place are coral rubble and abundant macroalgae.

Caribbean coral reef ecosystems also have yet to recover from a die-off of the long-spined sea urchin about 20 years ago. There is evidence that the loss of this key algal grazer coupled with over-nutrification and overfishing of herbivores may have contributed to the shift from a coral-dominated ecosystem to a macroalgae-dominated system on many reefs.

Like the Caribbean, the U.S. Pacific island shallow-water coral reefs are currently recovering from natural disturbances occurring over the past two decades – first a crown-of-thorns starfish invasion of several island groups[139] in 1979, then several periods of warm temperatures that caused coral bleaching, with the worst in 1997-1998. Chronic human impacts on coral reefs located near populated areas[140] add to these sources of stress.

Human impacts play a large role in the condition of most reefs, particularly those near population centers. Coral reefs in the Main Hawaiian Islands, American Samoa, Guam, and the CNMI suffer from degradation related to population growth, urbanization, and development. On the more

Figure 137. Giant clams have been over-fished throughout much of their range (Photo: James Maragos).

[139] American Samoa, Guam, and the CNMI.

[140] Pago Pago Harbor, American Samoa; Apra Harbor, Guam; Kane‘ohe Bay and Honolulu Harbor, O‘ahu, Hawai‘i; and Saipan Lagoon, CNMI.

Figure 138. Elevated levels of PCBS have been found in the tissues of the Hawaiian monk seal (Photo: USFWS).

populated Pacific islands, ocean outfalls of sewage and massive coastal tourist development (hotels, golf courses) are major sources of runoff, nutrient enrichment, and sedimentation, any one of which degrades reef. Most shallow-water reefs near urbanized regions are exposed to both acute and chronic anthropogenic impacts, and the synergism among natural and human impacts exerts a far greater influence than any single factor.

For the most part, the proliferation of macroalgae has not been a problem in the Indo-Pacific region. The native algae found around islands indicate either low-nutrient environments or heavy grazing by herbivores. So despite changes in coastal land use and other human impacts, there are still breath-taking examples of healthy reefs around the Pacific Islands, as evidenced by their high ranking world-wide as dive and snorkel sites.

For many Pacific islands, there has been heavy fishing pressure on large apex predators[141], resulting in fewer and smaller groupers, snappers, and jacks. Species such as giant clams, parrotfish, and humphead wrasse have been overfished on shallow-water coral reefs near major population centers (Fig. 137).

Pollution of toxic heavy metal and organic chemicals are affecting reef organisms in several areas. This concerns resource managers and conservationists worldwide. Toxic compounds are now showing up in fish from Pago Pago Harbor, Saipan Lagoon, and Apra Harbor. Even the endangered Hawaiian monk seals in the Northwestern Hawaiian Islands have been found to have high levels of polychlorinated biphenyls (PCBs) in their tissues (Fig. 138).

Degradation and loss of habitat impacts reef species. The endangered hawksbill and the threatened green sea turtle are in serious decline from illegal harvest and loss of nesting habitat throughout their range (Fig. 139).

In contrast, the Northwestern Hawaiian Islands, the Flower Garden Banks National Marine Sanctuary, Navassa Island, and remote Pacific Island refuges where there is little human impact other than long-distance fishing, remain relatively pristine. For these 'jewels,' live coral cover and species diversity range from relatively low off geologically young volcanic islands (e.g., Nihoa and Necker Islands in the NWHI) to high with an impressive degree of complexity (e.g., remote island atolls). For these reefs, disease and mortality is generally thought to be low. With the exception of Palmyra Atoll, the same is true for bleaching. Shallow reef fish communities on the remote reefs exhibit substantial populations of large apex predators and herbivores that are now rare in the Main Hawaiian Islands from fishing pressure.

The United States has a relatively pristine, remote, and expansive coral reef ecosystem that is ideal for coral reef conservation – the NWHI. These coral reefs are in excellent condition their near-shore coral reefs have been protected as National Wildlife Refuges. Over the past 95 years, these refuges have only allowed limited fishing by permit.

They are among the few remaining intact, large-scale, predator-dominated reef ecosystems left in the world. It is an opportunity for us to understand how unaltered ecosystems are structured, how they

Figure 139. Practically all species of sea turtles are endangered or threatened (Photo: NOAA).

[141] The largest predators at the top of a trophic or food web – snapper, grouper, jacks, and sharks.

Figure 140. Giant ulua are one of the apex predators that account for a large percentage of fish biomass in the Northwestern Hawaiian Islands (Photo: NOW-RAMP Expedition/ Bishop Museum).

function, and how they can most effectively be preserved (Friedlander and DeMartini 2002).

These authors contrast the NWHI (a large, relatively inaccessible and lightly fished area) with the Main Hawaiian Islands (MHI, especially those that are urbanized with heavily fished areas). The differences in the numerical density, size, and biomass of the fish assemblage are dramatic. Grand mean abundance of fish in the NWHI was more than 260% greater than that of the MHI. Of this, more than 54% of the total fish biomass in the NWHI consisted of apex predators (Fig. 140), while this trophic level accounted for less than 3% of the fish biomass in the MHI. In contrast, fish biomass in the MHI was dominated by herbivores (55%) and small-bodied lower-level carnivores (42%). Most of the dominant species by weight in the NWHI were either rare or absent in the MHI. The target species that were present, regardless of trophic level, were nearly always larger in NWHI.

In broad, general terms, there is a significant body of published literature on aspects of U.S. coral reef ecosystems. There are qualitative assessments on the condition of corals and harvested fishes for many localities. Coral reef managers know generally what to guard against and, in most cases, what conservation measures would most likely have an impact on their reefs (J. Ogden pers. comm.).

There is now a body of evidence that implementation of no-take conservation measures work to reverse declining trends for many species. Where no-take provisions have been implemented in MPAs[142], there were more and larger fishes and motile invertebrates within a year or so. Also, there are examples where coral reef ecosystems responded relatively quickly after disasters[143] – the algae, corals, and fishes rebounded to pre-impact levels. This generally occurred where overfishing and other human impacts were minimal but that may not be the case for slow-moving or sessile reef species[144] when they are subjected to repeated stresses, both local (e.g., nutrification, overfishing) and global (sea surface warming and bleaching). These species may not be able to respond within a human lifespan.

There is general consensus among scientists and USCRTF members that at least 20% of US coral reef ecosystems need protection by no-take provisions. The Hawaiian Islands provide textbook

Figure 141. Hanauma Bay (Photo: James McVey).

examples of reef ecosystems that are in near pristine condition (the NWHI), those that have been overfished (the MHI), as well as those that have been managed by no-take zones and are recovering (Hanauma Bay no-take protected area).

Scientists generally agree that reef fisheries on the Main Hawaiian Islands are depleted except in a few of the small no-take reserves (J. Maragos pers. comm.). For example, the Hanauma Bay Marine Life Conservation District, closed to fishing since 1967, supports more biomass of targeted species of reef fish than the rest of O‘ahu (A. Friedlander pers. comm., Fig. 141). The Merritt Island National Wildlife Refuge off the Kennedy Space Center demonstrates that no-take reserves can replenish nearby overfished areas with large and abundant fish (Roberts *et al.* 2001).

[142] The no-take for spiny lobster provision in the Dry Tortugas National Park, the grouper spawning ground closure off St. Thomas Island, the Merritt Island National Wildlife Refuge protecting Cape Canaveral.

USCRTF members acknowledge degradation from human influences is a global problem and U.S. coral reef ecosystems need to be included in international efforts such as the GCRMN. A Caribbean example of international linkages among coral reef ecosystems is water circulation patterns over FKNMS reefs have inputs 'downstream' from Cuba and Central America (Fig. 142). There are benefits (e.g., larval recruitment to the reef) but also detriments (e.g., aquatic and atmospheric transport of organic pollutants, J. Ogden pers. comm.). A Pacific example of this international exchange among ecosystems, Kingman and Palmyra Atolls, the two remote U.S. wildlife refuges that have the highest diversity. They are not only large atolls with a variety of lagoon habitats, but ocean currents bring a diversity of planktonic recruits from 'upstream.' Seasonally, the Equatorial Countercurrent flows past these atolls, providing them with the larvae of species from far western reefs, in addition to larvae coming from the east when the North and South Equatorial Currents flow past these reefs.

The Coral Reef Conservation Act of 2000 requires the Secretary of Commerce to prepare a conservation strategy and to report biennially on the effectiveness of conservation measures. Toward this end, NOAA initiated a process that will unfold over the next few years. In 2002-2003, NOAA and its partners will develop and test a 'report card' approach using indicators and metrics that can reliably show the condition of U.S. coral reef ecosystems. It will also evaluate the 'effectiveness of conservation measures.'

Figure 142. Due to oceanic circulation patterns, the health of reefs in Florida is tied to the fate of reefs in other areas of the Caribbean (Photo: Chuck Savall).

This report finds:

- U.S. coral reef areas are extensive.
- Healthy reef ecosystems are critical for local and regional economies.
- All jurisdictions still have some reefs in good-to-excellent health. These need conservation.
- All shallow reefs near urbanized coasts are degraded to some extent. These need restoration.
- Areas next to densely-populated shorelines generally have poorer water quality than those far from human habitation. Where water quality is fair to poor, reef ecosystems are degraded. Water quality needs to be improved in those areas, and measures taken to maintain the water quality of areas where reef condition is now deemed good-to-excellent.
- Coastal development, runoff, and sedimentation have impacted reefs around most high islands. These impacts need to be minimized.
- Fishing pressure has been a primary factor impacting reef ecosystems for decades. There is evidence that overfishing has changed ecosystem structure and function. Different and effective methods of management need to be implemented.
- Remote reefs with little coastal development, good water quality, and low fishing pressure are in excellent health, as characterized by many large fish and generally high species diversity within the reef community. These need to be studied and preserved.
- Marine refuges with no-take provisions produce more and larger fish. With enough time, they can conserve reef communities and long-lived species, producing trophy-sized apex predators. More no-take areas need to be implemented within MPAs in order to reach the USCRTF goal of 20% protection.
- Some existing marine protected areas are not protecting reefs. Regulations within these need to be strengthened and adequately enforced.

[143] Fagatele Bay National Marine Sanctuary and the Flower Garden Banks National Marine Sanctuary both of which involved a substantial change in keystone urchin populations.

[144] Queen conch in the Caribbean, and shallow-water coral colonies that suffered high mortalities from bleaching off Florida.


NATIONAL SUMMARY